



Payload Operations Integration Working  
Group (POIWG)  
January 28, 2014

**Human Research Program  
(HRP)**

**Nichole Schwanbeck & Gina Miller**

## HRP Increment 41/42 Overview

Increment Manager  
Nichole Schwanbeck/ NASA

Increment Lead  
Gina Miller/ LM

Increment 41 Operations Lead  
James Thaxton/ LM

Increment 42 Operations Lead  
Curtis Kershner/ LM





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## **AGENDA**

- **HRP Experiments**
  - HRP Inc 41/42 Complement
  - New HRP In-flight Experiments
- **Other In-Flight Activities**
  - Facility Activities
  - Support to IP Activities
- **Challenges**
- **Backup Charts: Investigation Summaries**



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## HRP Inc 41/42 Complement

### Experiments

- **Astro Palate**
- Biochemical Profile
- Bisphosphonates (Control)
- Body Measures
- Cardio Ox
- **Cognition**
- **Force Shoes\***
- Journals
- Microbiome
- **NeuroMapping**
- Ocular Health
- Pro K
- Repository
- Salivary Markers
- Sprint (Control)
- Sprint (Active)

### Pre/Post Only

- Intervertebral Disc Damage
- Manual Control

### Previous Increments

#### **New**

37/38 – 39/40

18 – 39/40

37/38 – 39/40

37/38 – 39/40

#### **New**

**39/40**

29/30 – 39/40

35/36 – 39/40

#### **New**

35/36 – 39/40

21/22 – 39/40 **FINAL**

16 – 39/40

37/38 – 39/40

31/32 – 39/40

27/28 – 39/40

33/34 – 39/40

33/34 – 39/40

*\*roll over crew time only if necessary*



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## Participation Matrix for HRP Experiments (In-flight)

Experiment	39S US	39S ESA	40S US	41S US	41S ASI
Astro Palate				✓	
Biochemical Profile	✓	✓	✓		✓
Bisphosphonates (Control)			✓	✓	
Body Measures	✓	✓		✓	
Cardio Ox	✓	✓	✓		✓
Cognition				✓	
<b>Force Shoes</b> (only if roll over time required)	<b>TBD</b>	<b>TBD</b>			
Journals	✓		✓	✓	
Microbiome		✓			✓
NeuroMapping (New)				✓	
Ocular Health		✓		✓	
Pro K [final subject]	✓				
Repository	✓	✓	✓		✓
Salivary Markers		✓	✓		✓
Sprint (Active)	✓				



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## Participation Matrix for HRP Experiments (Pre/Post)

Experiment	39S US	39S ESA	40S US	41S US	41S ASI
Intervertebral Disc Damage (IVD)			✓	✓	
Manual Control	✓			✓	



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## **HRP Inc 41/42 New In-flight Experiments**

- Astro Palate
- Cognition
- NeuroMapping





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# Astro Palate

## PRINCIPAL INVESTIGATOR

- Zata M. Vickers, Ph.D., University of Minnesota, St. Paul, MN

## RESEARCH OBJECTIVES

- The experience of flight is inherently stressful, and individual's moods and stress levels are not just nuisance factors that affect their quality of life. Moods and stress also have a significant impact on physical health. This experiment will focus on the role of food and the eating experience as a strategy for lowering the stress or negative moods that astronauts might normally experience in flight. It will also explore ways to minimize stressful aspects of the eating situation so that individuals consume more food and are more satisfied with it. The study has three parts to accomplish this as described below, each followed by a questionnaire.

## IN-FLIGHT OPERATIONS

- Part A - Menu Choice: Crewmembers will choose food items from the standard on-orbit menu for lunch. Day 1 and Day 2 menu will be duplicates of each other and Day 3 and Day 4 menu will be duplicates of each other as well. The crewmember will eat lunch alone on the days of this study.
- Part B - Prepackaged Foods: Based on responses to the preflight questionnaire, six special meals will be prepared for the crewmember. The six meals are divided into two sets of three and all meals in each set are identical. For each set, one meal will be eaten alone, one with others, and one on a special day (e.g., their birthday, a day they video chat with a famous person, etc.) with others.
- Part C - Snack Food: This study will utilize negative moods that 'naturally' occur in space. During the preflight session, crewmembers will list comfort and neutral foods as well as tasks that they are commonly required to do in flight that they feel put them in a generally negative mood.





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# Cognition

## PRINCIPAL INVESTIGATOR

- Mathias Basner, Ph.D., M.D., MSc, Philadelphia, PA

## RESEARCH OBJECTIVES

- Given the breadth of neurocognitive functions required for effective performance in space, the need to medically manage sleep and fatigue in space, the very limited neurocognitive assessment tools currently in space flight, and the often anecdotal nature of cognitive complaints from space flight, there is a critical need for rapid objective assessment of a range of neurocognitive performance functions in space flight. This project will achieve this goal by developing a much-needed practical, yet comprehensive cognitive test battery, validating its sensitivity to fatigue and fatigue countermeasures, determining astronaut norms for the test battery, and establishing space-flight feasibility of the battery.

## IN-FLIGHT OPERATIONS

- Cognition consists of 10 brief cognitive tests, each 1-3 minutes in length. The tests will be performed 11 times in-flight. Crewmembers will perform tests on the following days: 4 times early in-flight with a 1-week interval (FD 6, 13, 20, 27), 7 times later in-flight at 19-day intervals (FD 46, 65, 84, 103, 122, 141, 160). Consumption of caffeine and medications potentially influencing performance will be surveyed in the software briefly prior to the start of each test battery. This test should be performed in the evening within 2 hours of going to bed.





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# NeuroMapping

## PRINCIPAL INVESTIGATOR

- Rachael Seidler, Ph.D., University of Michigan, Ann Arbor, MI

## RESEARCH OBJECTIVES

- This research is being conducted to identify if there are any changes in brain structure, function, and network integrity as well as human motor control, spatial processing and multi-task performance abilities as a function of long-duration spaceflight. It will also determine how long it would take for the human body / brain to recover from such adaptations. This research will help generate relationships between structural and functional brain changes, correlated to human performance over time.

## IN-FLIGHT OPERATIONS

- Subset of behavioral assessment tests will be performed including a mental rotation test, dual task test, and a joystick-based sensorimotor adaptation test. Three (3) in-flight sessions are required on FDs 30, 90, and 150 (flexibility +/- 10 days). Each in-flight session will require 50 minutes of crew time. In-flight sessions will utilize the existing HRF PCs and ESA's universal serial bus (USB) joystick. Photos will be taken for documentary purposes, one session per subject (10 minutes of crew time).



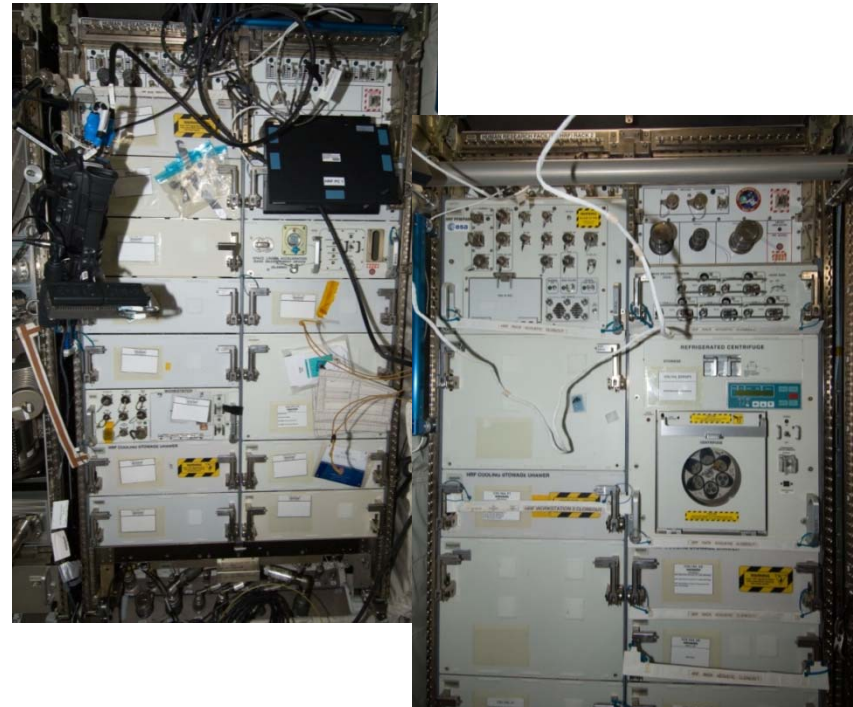
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## **HRP Inc 41/42 Facility Activities**

- Build 14 DVD/RIC 10.0 Installs
- HRF Supply Kit Logistics
- GDS/PFS Gauge Photos
- PFS Software Update for RVU/ACMS
- PuFF Syringe Maintenance
- Ultrasound Configuration Maintenance
- SLAMMD Control Run





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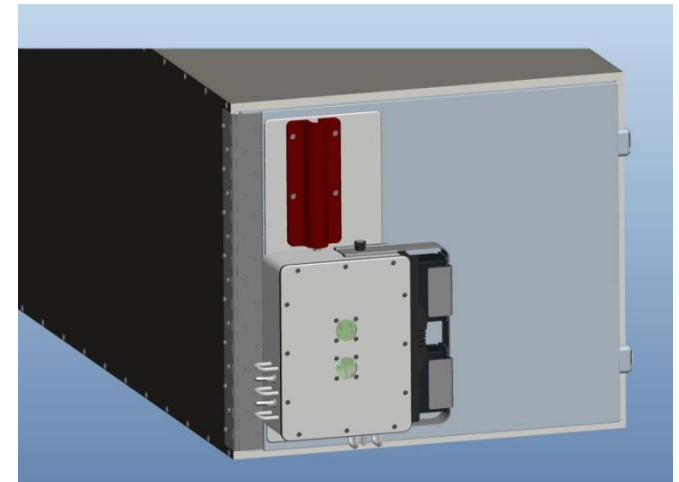
# Medical Consumables Tracking (MCT)

## PRINCIPAL INVESTIGATOR

- John Zoldak, Glenn Research Center

## RESEARCH OBJECTIVES

- Medical Consumables Tracking is a hardware demonstration project that will use RFID technology to track medications and medical consumables on ISS. This will assist in determining the quantity of medicine and medical supplies needed for long duration missions.



## IN-FLIGHT OPERATIONS

- Installation and activation consists of mounting the electronics box to the CHeCS Rack D2 door, installing the antennas inside the D2 locker, and battery installation. This activity will be coordinated with resupply or change out of the Convenience Medical Pack.
- Following activation, it will automatically scan the contents of the Convenience Medical Pack every 30 days and send a file wirelessly to the SSC via the JSL for downlink.
- Change-out of the battery (crew tended activity) will be required when a low battery indication appears (approx. every 3 to 4 scans).



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## **HRP Inc 41/42 Support to IP Science**

### **ASI**

- **Bone/Muscle Check** – Uses Urine Collection Devices (UCDs), Urine Collection Bags (UCBs) and Saliva Collection Hardware.
- **Drain Brain (part of Delta ICB) – Uses HRF Ultrasound2 and HRF Pulmonary Function System (PFS)**

### **CSA**

- **BP Reg** – Uses HRF PFS and CBPD

### **ESA**

- **Airway Monitoring** – Uses HRF PuFF Calibration Syringe
- **Energy** – Uses HRF PFS

### **JAXA**

- **Biological Rhythms 48** – Uses Actiwatch Reader & Cable



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## HRP Inc 41/42 Challenges

- Blood Volume Limits
  - Only so much blood may be collected from a crewmember during a given time span (“30 day rolling blood volume limits”)
  - HRP carefully manages experiment requirements and crew blood volumes
  - ***Timeline changes affect blood volume calculations and could impact science***
- Fluidity of visiting vehicle traffic
  - Limited upmass availability could impact HRP resupply
  - Limited downmass capability for cold stowage



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## Inc 41/42 HRP Contact Information



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## **Back Up Slides**





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## **Pre-/Post- Investigation Summaries**

### **Intervertebral Disc Damage:**

Alan Hargens, Ph.D.

**Brief Research Summary:** The goal of this study is to use state-of-the-art imaging technologies to comprehensibly characterize and quantify space-flight induced changes in disc morphology, biochemistry, metabolism, and kinematics. Subjects will be imaged before and after prolonged spaceflight. These data will be correlated with low back pain that spontaneously arises in space so as to establish pain and disc damage mechanisms that will serve as a basis for future countermeasure development.

**Data Collection:** Pre-/Post-flight testing only; involves MRI testing.



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## **Pre-/Post- Investigation Summaries**

### **Manual Control:**

Stephen Moore, Ph.D.

**Brief Research Summary:** Lack of gravity causes sensorimotor deficits post-landing. This experiment's comprehensive cognitive/sensorimotor test battery will determine the relative contribution of specific mechanisms (including sleepiness and fatigue) underlying decrements in post-flight operator proficiency. These results will be critical in determining whether sensorimotor countermeasures are required for piloted landings and early surface operations, and what functional areas countermeasures should target.

**Data Collection:** Pre-/Post-flight testing only; involves physiological and performance measures.



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## Investigation Summaries

### **Biochemical Profile:**

Robert Pietrzyk, M.S.

**Brief Research Summary:** Blood and urine are commonly used to assess an astronaut's health as well as conduct research in physiological disciplines by measuring key biomarkers found in these fluids. In support of research studies, this project will collect, process and store blood and urine samples obtained during the preflight, in-flight and postflight phases of ISS missions and maintain a database of results from the analysis of these samples. This database will offer supporting evidence to scientists by providing metabolic profiles of the effects of spaceflight on human physiology.

**In-Flight Data Collection:** 24-hour urine collection, blood draw and subsequent processing.



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## **Investigation Summaries**

**Bisphosphonates (Control):** Adrian Leblanc, Ph.D. & Toshio Matsumoto, Ph.D.

**Brief Research Summary:** Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss. The purpose of the Bisphosphonates study is to determine whether an antiresorptive agent, in conjunction with the routine in-flight exercise program, protects International Space Station (ISS) crewmembers from the regional decreases in bone mineral density documented on previous ISS missions.

Control subjects will not ingest the bisphosphonate pill in order to provide a comparison.

**In-Flight Data Collection:** 24-h Urine collection, Diet/Exercise Logs



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## Investigation Summaries

### **Body Measures:**

Sudhakar Rajulu, Ph.D.

**Brief Research Summary:** Currently, NASA does not have sufficient in-flight anthropometric data (body measurements) gathered to assess the impact of physical body shape and size changes on suit sizing. This study will involve collecting anthropometric data (body measurements) using digital still and video imagery and a tape measure to measure segmental length, height, depth, and circumference data for all body segments (i.e., chest, waist, hip, arms, legs, etc.) from astronauts for pre-, post-, and in-flight conditions.

**In-Flight Data Collection:** Circumference measurements with a tape measure along with photographic and video imagery.



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## Investigation Summaries

### **Cardio Ox:**

Steven H. Platts, Ph.D.

**Brief Research Summary:** Future human space travel missions may increase the risk of oxidative and inflammatory damage primarily from radiation, but also from psychological stress, reduced physical activity, diminished nutritional standards and exposure to altered oxygen levels during extravehicular activity. There is evidence that higher levels of oxidative and inflammatory stress and associated damage to blood vessels contribute to cardiovascular disease. The purpose of this study is to measure levels of biomarkers in blood and urine that are affected by oxidative and inflammatory stress before, during, and after long duration spaceflight and relate them to the risk of developing atherosclerosis.

**In-Flight Data Collection:** Ultrasound scans (carotid/brachial) with ECG recording, blood draw and 24-h Urine collection.



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## Investigation Summaries

### Journals:

Jack Stuster, Ph.D.

**Brief Research Summary:** This study converts behavioral and human factors information contained in confidential journal entries into quantitative data concerning the importance of the various behavioral issues involved in extended-duration space exploration.

**In-Flight Data Collection:** Periodic journal entries





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## Investigation Summaries

### Microbiome:

Hernan Lorenzi, M.D.

**Brief Research Summary:** The Microbiome experiment investigates changes to astronauts' immune systems and microbiomes (the collection of microbes that live in and on the human body). These changes can be detected by taking periodic samples from different parts of the body and the surrounding International Space Station (ISS) environment. As part of this study, the likelihood and consequences of alterations in the microbiome due to extreme environments, and the related human health risk, will be assessed.

**In-Flight Data Collection:** Blood, Saliva, Perspiration, Potable water collections; Microbiome (body swab), ISS Surface, and optional Gastrointestinal sampling.



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## Investigation Summaries

### Ocular Health:

Christian Otto, M.D.

**Brief Research Summary:** The International Space Station (ISS) Ocular Health Protocol aims to systematically gather physiological data to characterize the Risk of Microgravity-Induced Visual Impairment/Intracranial Pressure on crewmembers assigned to a 6 month ISS increment. The data collected will mirror Medical Requirements Integration Documents (MRID) requirements and testing performed during annual medical exams with an increase in the frequency of in-flight and post flight testing to more accurately assess changes that occur in the visual, vascular, and central nervous systems upon exposure to microgravity and the resulting fluid shifts. Monitoring in-flight changes, in addition to post flight recovery, is the main focus of this protocol.

**In-Flight Data Collection:** Fundoscopy, Tonometry, Visual Testing, Ocular Ultrasound, BP and Vascular Compliance (cardiac ultrasound, BP, EKG)



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## Investigation Summaries

### ProK:

Scott M. Smith, PhD.

**Brief Research Summary:** The Dietary Intake Can Predict and Protect Against Changes in Bone Metabolism during Spaceflight and Recovery investigation is NASAs first evaluation of a dietary countermeasure to lessen bone loss of astronauts. Pro K proposes that a flight diet with a decreased ratio of animal protein to potassium will lead to decreased loss of bone mineral.

**In-Flight Data Collection:** Controlled/monitored diet with urine and blood samples.



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## Investigation Summaries

### **Salivary Markers:**

Richard J. Simpson, Ph.D.

**Brief Research Summary:** The Salivary Markers investigation involves the collection of blood, saliva, urine and a health assessment on six subjects pre-, in- and post-flight to determine if spaceflight induced immune system dysregulation increases infection susceptibility or poses a significant health risk to crewmembers onboard the International Space Station. The investigation utilizes a longitudinal, repeated measures design to determine the effects of long-term exposure to microgravity on a host of salivary antimicrobial proteins (AMPs), latent viral reactivation, antibacterial properties of saliva, and blood markers associated with innate host immune defense.

**In-Flight Data Collection:** Blood draw, Saliva sampling, 24-hour urine collection, and Health Assessment using Med Ops' Data Collection Tool (DCT)  
FD 90 and R-1 blood samples will return ambient on Soyuz



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## Investigation Summaries

### **Sprint (Active):**

Lori Ploutz-Snyder, Ph.D.

**Brief Research Summary:** The Sprint experiment evaluates the efficacy of exercise countermeasures; this includes detailed measurements of cardiovascular and muscle function and bone health and evaluates the effectiveness of a new exercise prescription integrating both resistance and aerobic training exercise. Control subjects will not follow the Sprint exercise protocol in-flight. They will follow the standard ISS exercise protocol and share exercise data with the Principal Investigator.

**Data Collection:** Pre-/Post-flight testing: involves DXA, QCT, MRI, Muscle Performance and Isokinetic testing. Muscle biopsies are optional. In-flight testing: VO2 Max, Ultrasound muscle volume scan, Sprint exercise protocol.